

II.—On the Terebrating Mollusca.

By WILLIAM CLARK, Esq.

To the Editors of the *Annals of Natural History*.

GENTLEMEN,

Norfolk Crescent, Bath, Oct. 12, 1849.

“Scire tuum, nihil est, nisi te scire hoc, sciat alter.”

THIS quotation, from one of the most sagacious of the satirists, is not meant to be applied here, as A. Persius employs it, to lash the inordinate vanities of authors craving to have their lucubrations committed to the press, but in its simple sense, as an incontestable aphorism, that unless we communicate our ideas and what we know to others, our knowledge is vain and nought. In conformity with this application of the sentiment above, I propose to state some important facts which I believe at present are not generally known relative to the boring *Pholades* and other *Acephala*, and particularly on the identity of *Pholadidea papyracea* and *Pholas lamellata* of authors, together with some curious facts in the organization of the Bivalve Mollusca.

To carry out these views, it will in the first place be necessary, to enable malacologists to form just conclusions on the matters I have sketched out, to furnish them with a correct account of the animals of *Pholadidea papyracea* and *Pholas lamellata*, accompanied by a short summary of comparison, after which I trust I shall be able to place the *voxata quæstio* of the boring functions of the *Acephala* on the irrefragable bases of certainty; and lastly, I shall communicate a most curious fact connected with the testaceous *Acephala*, which, if hitherto unknown and now established, must be considered most important, inasmuch as it will add a function of the first consideration to the œconomy of these animals.

Pholadidea papyracea, Brit. Moll.*Pholas papyracea*, auctorum.

Animal elongated, subcylindrical; mantle closed, except a small rayed aperture for the foot, as long as one exists, and which corresponds in position with a similar aperture in the membrane connecting the doming of the shell, and is styled by Dr. Turton a “spiracle,” but which may perhaps in this species, the only one of the *Pholades* that has it, be for the purpose of a partial issue, or rather protrusion, without the solution of continuity of the ventral membrane of the animal, of the hyaline cylindrical appendage which exists in all bivalves, to secure for it a point of support when the foot becomes so much diminished as not to afford one. In all other bivalves this stylet is not visible, being imbedded in the body and upper part of the pedicle of the foot, which is the leaning-stock or point of resistance,

except in the *Anomia*, *Ostrea* and *Pectinida*, in which, as the foot is reduced almost to nothing, the mass of the body is the only *point d'appui*; but when the dome of the shell of the *Pholadidea papyracea* is removed, the dark basal point of the stylet presents itself in the centre of the mottled belly, precisely where the foot is placed in the group of the *Pholades*, and in this case it appears to act as a substitute.

The siphonal apparatus consists of a long elastic sheath, which is often protruded to double the length of the shell, but in a state of half-extension it becomes highly corrugated; it is clothed with a dull red-brown epidermis, under which it is bluish white; the margin of its terminus is finely fringed with short white cirrhi; within the sheath are the anal and branchial tubes, the former with the margin quite plain, but exserts a tubular hyaline process; the latter is encircled by about twenty white cirrhi of different lengths.

The liver is green, and situated as usual on the dorsal range. There are on each side the body a pair of pale reddish brown elongated suboval branchiæ, the upper one being much the smallest, which are finely striated on the outer surfaces; their posterior extremities suddenly become linear, and are then deposited in the branchial tube; there are also two long flat linear palpi on each side, with lanceolate points; these are more striated than the branchiæ. The body is centrally subglobose, but tapers posteriorly and anteriorly to a blunt terminus, and the whole of it presents, especially in the genial season, a mottled mass of flaky white subrotund spots or dots, with one of the termini of the elastic appendage appearing in the centre of the anterior extremity. With regard to the foot, as I have already observed, not a trace is visible, having vanished for reasons to be spoken of in another place.

Pholadidea papyracea, Brit. Moll.

Pholas lamellata, auctorum.

Animal nearly of the form we have just described; mantle closed, except a large aperture for the passage of the foot, which in this form of the *P. papyracea* is most apparent. The branchial processes and siphonal tubes are, in the *most minute points*, similar to those organs in the form styled *Pholadidea papyracea* to which we refer; the body, as in it, is subglobose, and produced posteriorly and anteriorly to an obtuse point, and it is generally of a bluish hyaline colour, with some fine anastomosing lines throughout its surface, but has nothing of the mottled appearance of *Pholadidea papyracea*; the shape of the branchiæ is the same as in its congener, but their striæ are more delicate and colour of the palest yellow; these are the mere variations of adolescence, and generally prevail where specific identity cannot be

doubted, and they are deposited partially as in its congener, in the branchial tube; the palpi and liver exhibit no variation. I now come to the most decided difference between the two animals; the foot, in the form we are now describing, is proportionally larger than in any other of the Pholades, of hyaline texture, springing from the centre of the body with a long cylindrical pedicle; it has a subclavate appearance, truncate at the terminus, which is of suboval form and pointed antecally and postally, and there is no outward visible trace of the curious elastic stylet common to all bivalves, and so conspicuous in the ventral tissue of the form *Pholadidea papyracea*.

I will now make a short comparison of the two forms: it will be observed that it is stated, in the form *Pholadidea papyracea*, that the mantle is closed, except a very small aperture or "spiracle" for the foot, if it still exists; but in the form *Pholas lamellata* there is a large aperture for a foot, that is, larger in proportion than in any of the Pholades. The branchiæ, palpi, and elaborate siphonal apparatus are precisely the same with only variations of colour; the bodies of the two are of the same shape, but differ in colour and markings, the one being intensely mottled, the other hyaline; the body of the one having *no* foot attached to it, but the other a very *large* one. These are the principal variations, and certainly constitute a very general difference of aspect between the animals of the two forms, and it must be admitted that conchologists and even malacologists, who have not examined with care all the conditions and incidents attached to them, have had a *primâ facie* case for doubting their identity; but notwithstanding these great and visible discrepancies, I think I shall, by a suite of facts, observations, and reasoning thereon, be able decisively to settle their specific identity.

But before I apply to this discussion, I propose to communicate what I consider to be the real agent of the Acephalous Mollusca in the operation of excavating their dwellings. This abrupt inroad on a subject only just mooted, will however, from the facts adduced, shorten the discussion when we revert to the subject we have for the moment abandoned, as they will I think satisfactorily account for some of the great variations of aspect between the *Pholadidea papyracea* and the so-called *Pholas lamellata* and other apparent anomalies. I disclaim all merit for the great discovery of the animal functions that are the principal agents of the excavating powers of the Acephala, and which will I think for ever set at rest the endless discussions thereon, by placing the subject on the indestructible bases of certainty.

This great result is due to the genius and talents evinced by Mr. Albany Hancock, in his paper in the 'Annals' of October 1848, "On the Boring of the Mollusca into Rocks." If any considerations are due to me, they are of the most negative character,

and only consist in the circumstances, that during the summers of 1848-9 I sedulously for several weeks examined the Pholades, both *in situ* and in the closet, when after a careful investigation I arrived at the same conclusions with respect to the boring agents of the bivalves as Mr. Hancock; and I have the notes of them now by me, written before Mr. Hancock's publication, which I intended to lay before the public; that gentleman has anticipated me, the whole merit is his, and I cordially apply to him the motto, "Palnam qui meruit, ferat." I will now state some facts which perhaps have escaped Mr. Hancock's attention, corroborative of his positive discovery.

I revert for a moment to the consideration of the identity of *Pholadidea papyracea* and the *Pholas lamellata* of authors, on which point Professor Forbes and Mr. Hanley, in the 'British Mollusca,' have concurred, having in some measure relied on my authority communicated many years ago. The investigation in the last summer (1848) was undertaken by me both with the view of making an attempt to discover the terebrating powers of the Acephala, particularly of the Pholades, and for further proofs of the identity of the two forms styled by authors *Pholadidea papyracea* and *Pholas lamellata*.

In the course of my examinations I was startled by the great variations in the organs of the two forms of this *Pholas*, which, twenty years ago, when I first examined this species, appear not to have so rigorously excited my notice; doubts arose in my mind, that I might be wrong in my former determinations of identity, and I wrote to Dr. Battersby to express them to him and Mrs. Griffith, both of Torquay; the latter a lady naturalist, who has taken great interest in this question; but in the present summer of 1849, after a continued investigation of fourteen weeks, my doubts were dispelled, and I stated personally to Dr. Battersby, that after a careful review of all the evidences that presented themselves, I reverted to and relied on my original determinations of identity of the two forms of *Pholadidea papyracea*.

This change of opinion arose from the observation that in the adult *Pholadidea papyracea*, the mottled appearance of the belly, so dissimilar to that of the form *Pholas lamellata*, was due to the extension of the reproductive membranous organs of the ovarium and the spermatozoa, occupying the space usually appropriated to the foot, which I found had disappeared. This anomalous appearance excited my attention, and the reflection that with nearly absolute *cæteris paribus*, in the generalities of all the Pholades, there was no substantial reason why one species should always be deprived of the foot, when all the others possessed that appendage, and as I had come to the conclusion, that it was the boring instrument, I felt assured that this anomaly was only

an apparent one, dependent on certain conditions connected with the growth of the animal ; and as the very large anterior gape in all the Pholades is the site of the powerful foot, and is never closed up during their existence, except in this species, I became fully convinced, that the foot,—having finally performed its terebrating functions, the animal consequently having arrived at full growth (the test of which is the doming and formation of the caliciform incipient tubing, which is in *Pholadidea papyracea*, the last vestiges of the protecting tubes of the *Teredinidæ*)—had become absorbed, on the well-known principle, that an organ from want of use is often, especially in the lower animals, followed by its total disappearance. This vanishing, depauperation, and withering away of a foot now become useless, and as it were extinct from its complete inclosure, after it had performed its appointed duty of excavation, is in strict conformity with Lamarck's views (see page 158, last edition of the 'Animaux sans Vertèbres'). Thus two most important facts are made evident by this phenomenon, which incontestably proves that the foot, agreeably to Mr. Hancock's views, is the excavator of the animal's dwelling ; and it stamps with additional consideration the Lamareckian doctrine of the progression and advancement of animality resulting from a want requiring to be supplied, which is effected by the concentration of the whole mass of vital energies, the circulation, nervous influences, aided by caloric, the gases, electricity, &c., in forcing and producing the supply of the particular want. That great philosopher instances the addition of tentacula to the Helices in explanation of his views ; and this doctrine is strongly corroborated, if the fact of the obliteration of the foot in *Pholadidea papyracea* is considered, *e contrario*, as a retrocession in animalization. This phenomenon also proves that nature never permanently retains what is superfluous, or refuses, as far as its power extends, to supply urgent requirements.

This important proof of the soundness of the laws promulgated by M. Lamarck, that nature mechanically produces the progressive march of animal improvement, almost makes us incline to assent to the high and metaphysical researches of that great naturalist, that the doctrine is not without foundation, that the first sparks of vitality arise from gravitation and molecular adherence, aided by the gases put in action by caloric, electricity, &c.* If we adopt this view, we admit that the germ of vitality communicated to matter arises from the mechanical power entrusted to nature ; but we must not for a moment forget that

* We would respectfully decline following our correspondent in these speculations.—R. T.

nature can do no more than perform the high behests of the Deity, nor exceed those limits of action confided to her by the Great Ruler of the universe, who is the *ens entium*, and the first cause of all that exists.

I revert to the boring Mollusca. Mr. Hancock has in many consecutive pages taken the pains to show, that mechanical boring, the solvents, and the ciliary currents, cannot be the causes of excavation. I shall not for a moment dwell on these agents, which are utterly worthless, and incapable of producing the effects attributed to them; but it may not be amiss to adduce some further observations corroborative of Mr. Hancock's position, that the foot is the true terebrating agent. As regards the *Pholades*, *Saxicavæ*, and the *Venerirupis perforans* of authors, they all inhabit the great littoral tracts of red sandstone on the Devon coasts, near Exmouth; this stone is composed of molecular grains so feebly conglomerated, that there is not the least necessity for the surface of the foot to be armed with siliceous points; the most gentle rubbing of that muscular coriaceous organ will amply suffice to hollow out the cubicula of the molluscan inhabitants of the red sandstone *on the Devon coasts*. The *Pholades* at Exmouth, and I believe elsewhere, are rarely or ever found in calcareous substances; the *Saxicavæ* are always in the sandstone; the *Modiolina gastrochæna* is never taken but in the coralline zone,—I speak of Exmouth,—and bores both stones and shells, as well as often forms its case of coarse agglutinated grains of sand or corally spoil. When the *Saxicavæ* and *Modiolina gastrochæna* are located in calcareous deposits, it is probable that nature in this case provides the foot or mantle with siliceous points; but I think the attrition of the foot, aided by fine simple sea-sand, is sufficient to rub down the cavities as fast as the animals grow. I corroborate by a thousand observations, that in the *Saxicavæ* and *Modiolina gastrochæna*, which have the foot slender and feeble, their mantles are strengthened by the most powerful muscular bands and fillets, which vary so much in shape, disposition and intensity, that I have in some cases used them successfully for specific distinction; and I have not the least doubt, as Mr. Hancock states, that this powerfully-armed ventral portion of the mantle of the closed boring Acephala is fully adequate to rub down their habitations. I believe that the foot or mantle of the entire class of Acephala has the power of terebrating, if circumstances require the exercise of it. It may be observed that many of the *Pholades* are not in all circumstances borers; many of them,—I may name the *Pholas dactylus* and *P. candida* at Exmouth, in the sandy districts,—pass their entire existence in pure sand; the same condition attaches to the *Venerirupis perforans* and many other bivalves. As to the borers

in wood, as the exotic *Pholas striata*, the *Teredines*, and *Xylphaga dorsalis*, the foot is the undoubted agent of perforation, and in this class is probably armed with rasping additions, and it cannot be doubted has the power to rub down the hardest oak faster than the animal can require; in fact, the harder wood, as oak, is more easily comminuted than the spongy deal or elm plank.

I take leave of this part of my present paper by again acknowledging the great service Mr. Hancock has conferred on malacological science, by definitively, as I think, determining the true functional causes of the terebrating powers in the Accephalous Mollusca.

I return to the question of the identity of the two forms of *Pholadidea papyracea*. I have already shown that the great variation in colour and markings between the adult *Pholadidea papyracea* and the young shell styled *Pholas lamellata* is the effect of generative influences, and that its conspicuous foot, when it arrives at full growth, which is testified by its becoming completely domed, is depauperated and finally obliterated. These two great and principal variations of aspect between the two forms of *Pholadidea papyracea*, resulting from states of transition, having I trust been satisfactorily disposed of, and every other part of the animal exhibiting a prototype similarity, it is impossible, as I think, to entertain further doubts of the positive identity of the two shells usually termed by authors *Pholas papyracea* and *P. lamellata*. I may add, that it has been asked in objection, how is it that twenty *Pholadidea papyracea* are taken for one *Pholas lamellata*, and that the two forms are not more frequently met with in the transition states? This objection quickly yields to a just view of the Pholades as regards habitat and other influences.

The Pholades are usually inhabitants of the littoral zone, but by no means always so, as some species also inhabit the more pelagic zones; the littoral shells are found in the superficial area of the red sandstone rocks from half-tide to the lowest littoral limits, and probably beyond, where they are unapproachable, at the depth of a very few inches; the whole area of the lower portion of the littoral zone is occupied by *pêle-mêle* colonies of *Pholas parva*, *Saxicava rugosa* and *Pholadidea papyracea*, generally of adult proportions, with an intermixture of a comparative paucity of the form *Pholas lamellata*. The *Pholas dactylus* and *P. candida* usually inhabit the higher levels of the littoral zone. The fact of the deficiency of the young of the *Pholadidea papyracea* is occasioned solely by the pre-occupation of the area of the sandstone rocks by the species I have mentioned, mostly adult; and when the genial season of reproduction arrives, the fry are ejected,

and vast numbers become, as I believe is the case with all the Mollusca, at least the majority, the prey of the Echinodermata, Crustacea and other enemies; therefore only a comparatively few survive, to continue the race and keep up the stock diminished by the annual demand for them, rarely for bait, but chiefly to supply the cabinets of the shell-collectors. These are the causes which fully account for the circumstance of twenty adult *Pholadidea papyracea* occurring for one in a state of adolescence; thus, in conformity with the Malthusian doctrine, the ground being pre-occupied, no more stock can be admitted until some of the older colonists are removed, and reproduction is consequently limited by the ova becoming the prey of a multitude of enemies.

I will say a few words on the pelagic Pholades inhabiting masses of stone dredged up in the littoral zones of the Devon coasts, six or eight miles from land. These shells, whether they are the two forms of *Pholadidea papyracea*, or the *Pholas parva* or *P. dactylus*, are always dwarf. I have a curious series of minute and completely adult *Pholadidea papyracea* not exceeding a quarter of an inch in length. Such shells are considered by the inexperienced observer as proofs that at all ages the *Pholadidea papyracea* is completely covered with a dome and continues gradually to increase: this is impossible, as when the dome and caliciform posterior extremity are once formed, all further growth is for ever terminated. The pelagic Pholades rarely exceed half an inch in length, consequently these dwarf forms are the result of locality, depth of water and many other conditions. In the deeper zones, the young forms of the present species, instead of being found in the proportion of one to twenty of the adult shells, appear in equal numbers: this discrepancy in the proportions of the young shells inhabiting the littoral and pelagic zones, must arise from the circumstance that in the deeper waters there is more room for reproduction, more sustentation and fewer enemies; this view corroborates the doctrine above, accounting for the disparity of numbers in the littoral zones between the young and old shells of this species. I have omitted to mention that I possess these shells in a genuine state of transition taken by myself *in situ*, and not produced by the arts of fraudulent dealers.

I terminate the present paper by stating a fact of the greatest importance in the œconomy of the Bivalves, which I believe is not generally known, and which was discovered by me twenty years since, but not then promulgated, except to a few friends, and lately I named it to Professor Forbes: though the fact was new then, I do not vouch that it is so now, as from my long secession from malacological pursuits, many of the recent discoveries,

scattered in the various works on natural history, may have escaped my attention.

All malacologists are acquainted with the existence of the hyaline cylindrical elastic stylet that is found in the bodies of all bivalves, whether great or small; I have seen this organ mentioned in a work on natural history that has escaped my memory, with the addition that its use is entirely unknown. Whilst dissecting the *Pholadidea papyracea* and other Pholades, in which this stylet is easily detected, and in which the larger end is imbedded in the muscular fundus of the body and foot, instead of drawing it forth as I had often done, I was induced to trace its course, and found that it terminated in the stomach, and had attached to it a light yellow doubled-up corneous subtriangular plate, wrinkled into three bluntly pointed lobes at one end, and at the other a membrane by which it is affixed to the elastic stylet. This discovery at once made evident the use of this appendage, and that it was an elastic spring to work the corneous plate or attritor, by the muscular action of the foot and body, to divide and comminute the food, and especially the minute crustaceous and testaceous alimentary matters received into the stomachal cavity; it appears then that this appendage acts as a gizzard, and the Bivalve Mollusca are thus supplied with a masticatory apparatus very analogous to the gizzards of some of the Gasteropoda.

I am, Gentlemen, your most obedient servant,

WILLIAM CLARK.

III.—*Descriptions of Aphides*. By FRANCIS WALKER, F.L.S.

[Continued from vol. iv. p. 202.]

72. *Aphis Persicæ*, Sulzer, &c.

Aphis Persicæ has been described by several authors, but I believe that this name will apply to two species, and I defer giving the references until I can ascertain to which of these they most probably belong.

This *Aphis* feeds on the peach, *Amygdalus Persica*, in Europe and in North America, and on the sloe (*Prunus spinosa*); the latter tree is its original habitation, but the introduction of the peach into England caused a partial change in its nourishment. It sometimes passes from the peach to the cherry, and multiplies thereon. Schmidberger states that there are sixteen generations in one year, and that some of the young ones of the second generation acquire wings.

The viviparous wingless female. It appears on the buds of the peach-tree before the end of March, and when young is very